those whose male lines are not traceable to such an early date. This bears on the average some relationship to the date of elevation to the peerage, but that is another matter.

These in the first group are the peers who belong to the very old families, so-called. They constitute about half of all the peers. Their family names are well known to everyone conversant with English history.

As regards their achievements, which must be in a considerable degree due to a mixture of ability, vitality and ambition, they have all been placed in two groups. First, a comparatively small group who have done nothing or next to nothing in the way of rendering public service and, second, a majority group whose public services appear to have been both genuine and continuous. Naturally there are border-line cases difficult to place, but these are not very numerous and I have been careful to place the doubtful cases in such a way that they would count against rather than in favor of my theory. Only those over 34 years of age have been included.

All who have been elected members of parliament or risen in the navy to the rank of commander or colonel in the army (not honorary colonel), also those who served in the great war, have been included in the "service" group as well as the few business and professional men. Both "Burke" and "Who's Who" have been consulted for each case. Generally speaking if there is anything in their biographies that can be called "service" they have been included in this group.

In spite of this liberality of inclusion in the "service" group there are about 68 among the peers of the newer families whose achievements appear to be either nothing at all, or very inconsiderable. These have 138 living children, which gives an average of 2.03.

There are about 274 peers of the newer families who come within the "service" group. These have 640 living children or an average of 2.33. An even greater rise is to be found in favor of the greater fecundity of the peers who have rendered "service" when we summarize the facts concerning the older families. Here about 70 peers with little or no public service to their credit have 131 living offspring or an average of 1.87, while 210 "service" peers have 610 living children. The average for living children here rises to the surprising height of 2.90.

The English peers evidently want children and they have them. The best among them apparently want them the most, so that in spite of the large number of sons killed in the war, this special caste of humanity is more than holding its own.

Dr. J. McKeen Cattell and others have shown that parenthood to-day is largely a voluntary matter, at least among the more intelligent classes. The desire for children is doubtless in part an instinct and as far as it is an instinct should be subject to hereditary transmission. It is in all likelihood correlated with such virtues as domesticity and stability. It appears from these figures to be also correlated directly with intelligence and ambition. When we reach the type of ability generally called genius there is again a falling off in the number of offspring, but it is a matter of satisfaction to know that within the different groups of humanity there is by-and-large a survival of ability.

The average for total offspring for all college graduates is lower than it ought to be to keep up the type. For all Harvard graduates it averages below two. Some may say, "What is the use of survival of ability when if this goes on long enough there will not be any ability left to survive." The answer to this is a long one and can only be indicated here. Voluntary parenthood is a recent phenomenon. The average for all graduates, *circa* 1.5, rises for the more successful to *circa* 1.6. As nowadays only those who want children have them, the children should themselves inherit this temperament. This is a new condition which did not exist until recently. From now on this inheritance of the parental instinct should in a few generations restore the number to a little over two, which is necessary for a continuance of the breed.

It is true that the people of the slums are having undesirably large families, but this class is now almost entirely separated as far as intermarriage is concerned from the upper classes—more so in England than in the United States, but increasingly so on both sides of the Atlantic. It is probable that an intensive study of families within the slums where brother could be compared with brother and sister with sister would show the same result, namely, the better members of the family having the largest number of surviving offspring.

FREDERICK ADAMS WOODS

QUANTITATIVE HYDROLYSIS OF STARCH BY BUFFERED TAKA-DIASTASE

THIS work represents an attempt to eliminate the use of acid hydrolysis in determining the starch content of plant material.

The standard method is the "maltose hydrolysis." This consists in treating the alcohol extracted materials with taka-diastase in water solution, filtering off the insoluble residue, and heating the filtrate with dilute acid to hydrolyze the dextrin and maltose to

glucose. The glucose content of the solution may then be determined by any standard method.

This procedure is open to criticism in that the water extract will contain any water soluble substance originally present in the material unless it was dissolved out by the alcohol. Since pentosans are insoluble in alcohol and soluble in water they may be present in the water extract. These, if present, would be hydrolyzed to reducing sugars by acid, and recorded as starch.

It is, therefore, desirable to use, if possible, a hydrolyzing agent more specific than acid. Enzymes in general are specific in their actions, and taka-diastase is the most efficient of the enzyme mixtures which attack starch. Much work has been done upon the optimum conditions for enzyme activity. The optimum temperature range for taka-diastase is 30°–40° C.[1] The optimum pH is 4.5–5.0.[2] The hydrolysis curve begins to flatten at 50 hours[3] and .2 gm. of enzyme is sufficient to dissolve .5 gm. starch.[4] Most of this information is in Waksman and Davison, "Enzymes," but curiously, data could not be found indicating that any one had put it all together. Kuhn[5] reports a curve for the hydrolysis of starch by taka-diastase at pH 4.5 for 50 hours at 36° C. in which he obtains 71.4 per cent. hydrolysis. He used 2 cc. of .5 per cent. enzyme solution for .603 gm. starch, so that it is probable that the quantity of enzyme was the limiting factor in that experiment. Horton[6] working with unbuffered solutions reports that it is impossible to obtain consistent results with taka-diastase. In this laboratory, when 50 cc. of .3 per cent. starch solution was held at 40° C. for 36 hours with 1 cc. 10 per cent. taka-diastase and 5 cc. acetate buffer (pH 5.0), glucose values representing 98.5–101.1 per cent. hydrolysis were obtained consistently.

The substrate was potato starch which had been purified by repeated washings with distilled water and dried in a vacuum oven at 120° C. over phosphorus pentoxide to constant weight.[7] The starch was not caramelized by this treatment. Furthermore, the analysis of undried starch of known moisture content gave concordant results. The reducing sugar was determined by the Schaffer-Hartmann[8] modification of the Munson-Walker method. The amount of reducing sugar produced by a maltose hydrolysis on another aliquot of the same solution was taken as the standard of complete hydrolysis.

Reducing the concentration of taka-diastase to ¾ did not decrease the amount of glucose formed, and ½ the amount of enzyme gave 95.6–99.0 per cent. glucose. It was impossible to obtain consistent results at pH other than 4.5–5.0 with acetate buffers. A phosphate buffer at 4.5 gave 100.1 per cent. glucose.

In view of the present interest in the structure of starch it is interesting to note that both acid and enzyme hydrolysis consistently gave results equal to 93 per cent., the dry weight of the sample. It is possible that the starch was impure and contained only 93 per cent. hydrolyzable material. Davis and Daish[9] working in England, report that acid hydrolysis of potato starch gives 93.8–94.5 per cent., the theoretical amount of glucose. They attribute the low results to destruction of glucose by the prolonged treatment with acid. If the enzyme hydrolysis be inaccurate, the fault probably lies in incomplete hydrolysis and the establishment of an equilibrium between dextrin, maltose and glucose. It seems improbable that this equilibrium point should coincide with the point reached by the destruction of glucose by acid hydrolysis. Noyes[10] says that the analytical ratio between starch and glucose is .93. The agreement between these three figures may be coincidental, but the point should be further investigated.

The method seems to give concordant results with pure starch, and one series of determinations on grape wood gave values identical with those obtained by the maltose hydrolysis, but the method needs more work before it can be considered reliable. The specificity of taka-diastase for hexonsans should be more carefully investigated. It is also possible that the time required for a determination may be shortened by the use of more concentrated enzyme solutions, or a different temperature.

I. D. COLLINS

VITICULTURE LABORATORY,
UNIVERSITY OF CALIFORNIA

[1] Euler, Chemie de Enzyme (Waksman); Kuhn, R.; Berichte der Chem. Gesell. 1924, 57: 2, 1965.

[2] *Ibid.*

[3] *Ibid.*

[4] This laboratory.

[5] Kuhn, R.; Berichte der Chem. Gesell. 1924, 57: 2, 1965.

[6] Horton: *J. Agr. Sci.*, 1921, 11: 240.

[7] Walker: *J. A. C. S.*, 1907, 29: 54.

[8] Schaffer and Hartmann: *J. B. C.*, 1920–21, 43: 371.

[9] Davis and Daish: *J. Agr. Sci.*, 1914, 6: 152.

[10] Noyes: *J. A. C. S.*, 1904, 26: 266.

THE NATIONAL ACADEMY OF SCIENCES

(*Continued from page 406*)

Studies in animal aggregations; protection of the individual by the mass: W. C. ALLEE (introduced by Frank R. Lillie). The injurious effects of crowding are easily demonstrated and have received due attention. Beneficial results from aggregations of animals without apparent social organization have escaped notice until recently,